Critical Digest.

ANATOMICAL, PHYSIOLOGICAL AND PATHOLOGICAL NOTES.

By HENRY H. DONALDSON, Ph.D.,

University of Chicago.

Notes on the Arrangement of some Motor Fibres in the Lumbo-Sacral Plexus.

By Chas. S. Sherrington, M.A., M.D., Lecturer on Physiology, St. Thomas Hospital, London, Fellow of Gonville and Caius College, Cambridge. (Plates xx., xxi., xxii., xxiii. The Journal of Physiology, Vol. xiii., No. 6, October, 1892.) This very extensive paper of 150 pages, illustrated by four plates, contains an amount of detailed information which is almost bewildering.

The observations are taken up under six sections as follows: Introduction; Method Employed for the Study of the Limb Muscles; Motor Roots to Muscles other than those of the Limb; Relation of the Limb to Cell-Groups in the Spinal Cord; The Significance of the Arrangement of the Limb Plexus; and the General Features of the Distribution of the Motor Nerve Roots to the Musculature of the Limb.

This series of investigations was made in order to clear the way for the study of reflex action in monkeys; for which the relation of the muscles examined, to the nerve roots, needed to be known.

In trying to determine which spinal roots were requisite for the contraction of a given muscle, the number of the problems here examined was developed.

To put it briefly there are two views concerning the structure of the ventral spinal roots.

According to the one which is current, viz, that supported by Ferrier and Yeo, the fibres which make up a ventral root are so related that their simultaneous stimulation causes a co-ordinated and purposive movement; or to quote the Authors: "represents some one highly co-ordinate functional synergy in the musculature."

The older view of Panizza considers that all the muscles of a limb are more or less represented in each of the spinal roots, supplying the limb.

The significance of the two views perhaps best comes out when the consequences of injury to the nerve roots are considered. According to the former view injury to a given root would cause a distinct loss of certain definite muscular combinations. According to the second view injury to a given root would only weaken the muscular power of the limb; but leave the combinations for the most part unaffected. In studying the limb-muscles, Sherrington used all the common laboratory animals including a number of monkeys.

To study the relations between a given nerve root and the muscles which it supplied, the animals were anæsthetized, the roots severed at their origin from the cord, and the root branches stimulated one by one within the spinal canal.

At times, in order to avoid any criticism from the possible escape of current, the roots in the neighborhood of the one to be investigated were all sectioned, and the electrical stimulus applied at the cortex. In almost all the animals examined the numerical designation of a ventral root would not necessarily indicate its function, for in different individuals of the same species there might be a displacement of a root with a given function through an extent of the spinal cord equal to one or two segments.

The relative position of roots with fixed functions was however the same whether the whole series had moved slightly cephalad or caudad. The former individuals are classed as those of the "prefixed" type and the latter as "postfixed."

In the frog, cat and monkey (Macacus Rhesus) details of these variations were worked out.

In this connection, Sherrington made an instructive study on the nervous mechanicism controlling the knee-jerk; which from its segmental limitations offers an admirable index for determining to which type a given animal belongs.

These types enumerated have been based on a study of the motor roots and a corresponding examination of the sensory roots has still to be made.

In considering the motor roots to muscles other than those of the limb, the author has something to communicate on the innervation of the anus, vagina, urinary bladder, the cremaster muscle, the round ligament of the uterus, the vas deferens, the penis and the hair. Not of the least interest in this connection is his demonstration of a cortical centre in the monkey, stimulation of which is followed by movements of the anus; and in the dog of a similar centre from which closure of the vaginal orifice can be obtained. The nerve supply to the anal sphincters and vagina is such that the whole sphincter contracts on the stimulation of the nerve from either side of the body, although the contraction can be shown to be more vigorous on the side of the nerve stimulated. On the contrary, the contraction elicited from the cortex is more marked on the opposite side. In studying the bladder the rhythmic contractions of that organ, while of interest in themselves, are very disturbing to the further determinations of its nerve supply. Since in the limb the distal muscles are most closely connected with the lowest nerve roots supplying the limb; and since the motor nerve roots emerge from the spinal cord at very nearly the level of the cells from which they arise, it was thought possible that a study of the cell-groups in the cervical and the lumbar enlargment of the cord would afford some ground for determining which group of cells in the ventral horns were connected with the different segments of the limb.

It appears that the postero-lateral cell-group is associated with the intrinsic muscles of the most distant segment of the limb that the medial group of cells is associated with the axial muscles of the trunk, and that in a general way the anterior group of nerve cells is connected with the more proximal segments.

In this connection, Sherrington discusses the lateral group of cells in the thoracic portion of the spinal cord, and their very interesting sympathetic connections.

Returning to the significance of the arrangement of the limb plexuses, we have to ask whether this arrangement is adapted to any particular physiological end, or whether it is the mere result of displacement due to the inequalities of growth, and having no particular physiological value.

If we consider the origin of the plexus, as some do, to be caused by the shifting of the limb along the axis, no physiology is needed by way of further explanation.

However, sharp distinction must be made between the constitution of the nerve roots and the plexus, which is formed by them. As far as the nerve roots are concerned, the innervation of the same muscle from several of them, and the fact that the strength of the muscular contraction increases with the number of roots that are stimulated, would indicate that perhaps under ordinary circumstances this subdivision was a protection against fatigue; the muscle being controlled by the fibres of one root for a time and then by the fibres of the other. Different nerve elements and different muscle elements being in both cases involved.

That this subdivision is carried very far, is indicated by the fact that even the small natural bundles, composing the nerve roots, contain fibres distributed to antagonistic muscles. It is interesting to note in this connection, that at least within the enlargment of the spinal cord, the segmental arrangement of the nerve cells has been quite obliterated, and instead of cells segmentally grouped, we have long columns of cells running through several segments, and what is more, not terminating in every case at the ends of segments, but often in the middle of a segment.

The last section of this paper is something of a resumé of what is gone before, with additional data on the kind of motion produced by the stimulation of the several roots.

As regards flexion and extension in the monkey, it appears that, "of the opposed movements of joints, the one directed towards the anterior aspect of the limb, has always a spinal representation more an erior in the spinal roots than is the representation of fellow movement of opposite direction."

A Microscopical Study of Changes due to Functional Activity in Nerve Cells.

C. F. Hodge, Ph.D. (Journ. of Morphology, Vol. vii., No. 2., 1892). Since 1887 the author has spent more or less time in studying the problem, indicated by the title, and the present paper collects together, and adds to, several smaller papers which had been published during this period.

At the present time the constituent cells of different tissues are being analyzed in much the same way that, a few years since, the tissues themselves were studied, and the detail of cellular structure thus brought to light is very great indeed.

With a knowledge of the finer anatomy of the cell, it becomes possible to study the changes which take place within it under certain conditions; in this connection